Space Weather Technical Forecast

Issued on Wednesday, 19 January 2022 at 00:34 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance of G1, mainly Thursday 20 January from 16 January CME. Chance of isolated M-class flares (R1/R2 radio blackouts) throughout. Electron Flux likely to be High during diurnal maximum with fluence above the 1e8 integrated pfu Active level.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with a Long Duration M1.5 X-ray flare from sunspot region AR2929 at 18/1744 UTC, this was followed by a C5.7 flare from AR2930 at 18/1951 UTC. The ejecta from this event was clearly visible in coronagraph imagery, it will be analysed for an Earth-directed component in due course. No other Coronal Mass Ejection (CME) event of note are visible in coronagraphs for the period. There are now four active regions on the visible disc. AR2929, AR2930 and AR2933 are the most noteworthy regions being bipolar. AR2927 in the southwest is uni-polar, stable and appears to be fading.
The C2 flare from AR2929 on 16 January produced a CME directed mainly to the northwest. This may pass Earth as a glancing blow early on Thursday 20 January.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1 was elevated due to connection to a high speed stream from CH44/-. The solar wind speed was typically between 550-600 km/s with occasional increases above 600 km/s, especially towards the end of the period. The solar wind density was near or slightly above normal before falling below average after 18/1300 UTC. The IMF was mainly weak, near 5nT before becoming moderate near 9nT after 18/2300 UTC, while the north-south component varied between -7 and +4nT. The phi angle was mainly negative (towards the sun) but with some brief forays into a positive sector.
The net result of the above solar wind measures was provisionally Quiet to Unsettled (Kp2-3) geomagnetic activity with a Minor Geomagnetic Storm/G1 (Kp5) observed between 18/0000 UTC and 18/0300 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 remained at Background levels throughout. High energy electron flux (greater than 2MeV) measured at GOES 16 was at Moderate becoming High from 18/1005 UTC, with a peak value of 4360 pfu at 18/1605 UTC. Electron fluence initially remained flat before rising quickly, exceeding the 1e8 Active threshold at 18/1800 UTC, with an 18/2359 UTC observed value of 1.5e8 integrated pfu recorded.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low with further C-class flares likely and a Chance of M-class flares.

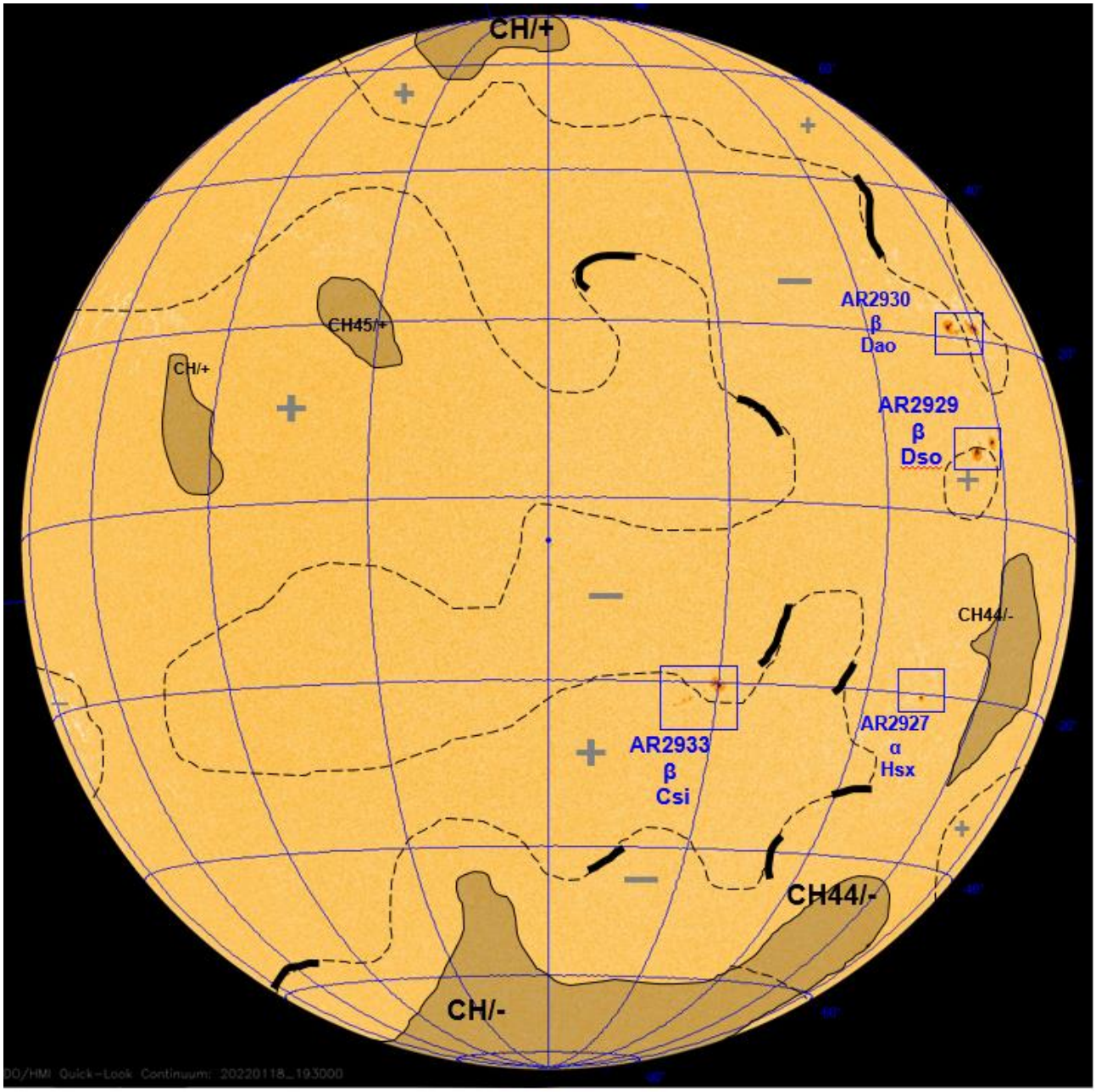
Solar Wind / Geomagnetic Activity: The CME from the C2 flare from AR2929 on 16 January may carry an Earth-directed component, with a possible glancing blow arriving early in the UTC day of Thursday 20 January. This gives perhaps a Slight Chance of G1. The CME from the M1.5 flare on the 18th will be analysed once more imagery becomes available. The only coronal hole feature due in the four days is expected to be the current one, CH44. A gradual decline toward a slow regime is therefore expected from day 2 (20th), with increasingly Quiet geomagnetic activity expected from an initial Chance of Active or G1. Should today's CME have an Earth directed component, or the 16 January transient impact Earth, then some enhancement in geomagnetic activity can be expected.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at Background levels.
The high energy electron flux (greater than 2MeV) is expected to be continue to breach High flux levels through the period, especially near the diurnal maximum. This will need reassessing should a CME impact Earth. The 24-hour fluence is expected to remain above the Active threshold.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 18/2000UTC.



.

Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

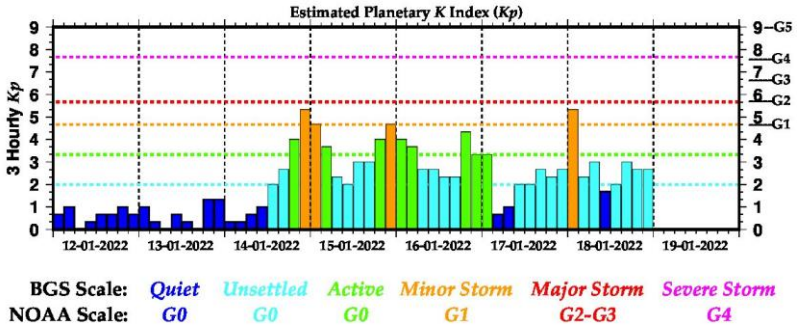
The CME from the C2 flare from AR2929 on 16 January is now considered to perhaps carry an Earth-directed component, as suggested by some MOSWOC Enlil Ensemble members. These point towards arrival early in the UTC day of Thursday 20 January, with a resultant Slight Chance of G1 proffered, but with low confidence. This analysis exclusively considered the portion of ejecta seen heading northwest on Lasco coronagraphs (also correlated with STEREO A COR2 data). There were also hints of material seen heading north and northeast on Lasco C2 at the same time - the attribution for these streams is not clear, however it is possible that they were produced in the same event, and this was therefore more of a partial halo CME. This uncertainty has influenced the inclusion of the northwestward portion in the forecast as a Slight Chance of G1, however it remains that confidence is low for the event as a whole.
The CME from the M1.5 flare on the 18th will be analysed once more imagery becomes available.
The only coronal hole feature due in the four days is expected to be the current one, CH44, which is now mature, with resultant geomagnetic activity very likely to have already peaked. A gradual decline toward a slow regime is therefore expected from midweek, with no further enhancements (barring the possible impacts from CMEs mentioned above) expected.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	1	20	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/0235 UTC	Partial	C2 flare from AR2926 on 16th Jan	NW	562km/s	20/0001UTC	Low confidence-glancing blow.

Figure 2: BGS Kp index.



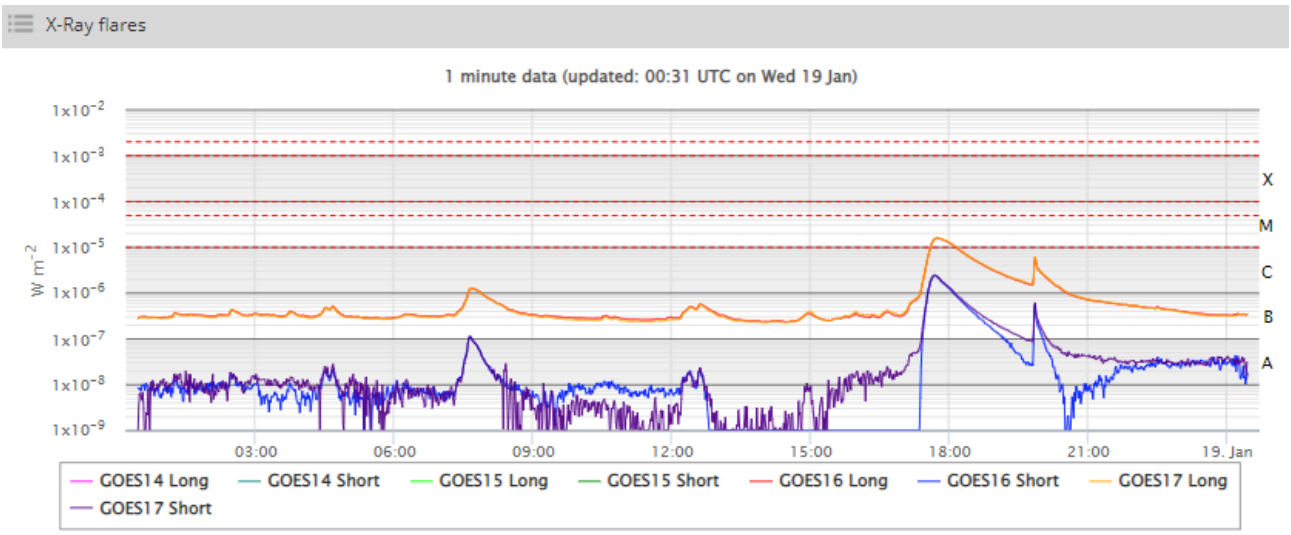
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
The overall trend in the front-sided sunspot groups has been of stability or slight decline in the past 24 hours. Despite this an M1.5 flare was observed from AR2929. There appears little prospect of significant returning regions arriving over the eastern limb in the four-day period. Relative to earlier guidance, the daily risk of M-class flares has been increased to reflect the M1.5 event.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	30	20	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES16 X-Ray flares shows the LDE M1.5 at 18/1744UTC



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 remains at Background levels. The M1.5 flare observed late on the 18th is leading to a slightly raised risk of S1 in the coming four-day period, although the effect is very slight.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

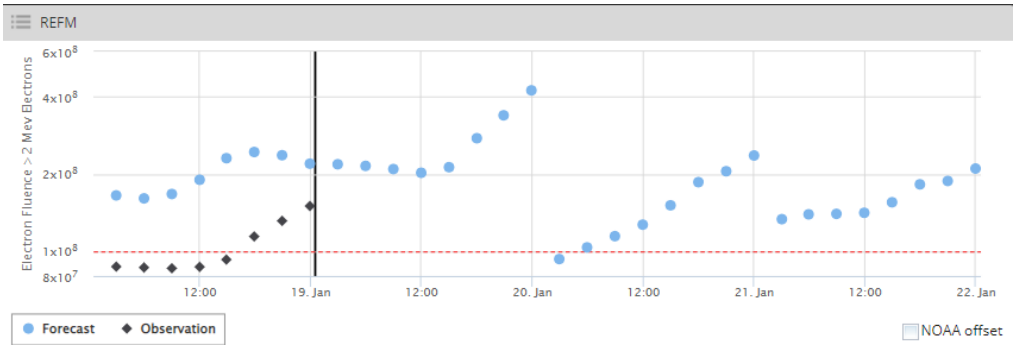
High energy electron flux (greater than 2MeV) has exceeded the 1e3pfu High level and is expected to continue to breach this value for the next four days, especially during the diurnal maximum. This is in response to the ongoing high speed stream from coronal hole 44.

24-hour integrated fluence is expected to remain above the Active threshold, at least for days 1-3 (19th-21st). Though confidence drops markedly with the potential complication of the 16 January CME passing Earth on Thursday 20 January.

The current level of response in high energy electrons is greater than that seen on last rotation in reaction to CH44's predecessor. REFM is considered to be offering good guidance at present, with levels mostly above the 1e8 integrated pfu threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	100	90	70	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	5	1	1	1

Figure 4: MOSWOC REF Model forecasting fluence levels above 1e8 Active level.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.